Goals of HCC workshop

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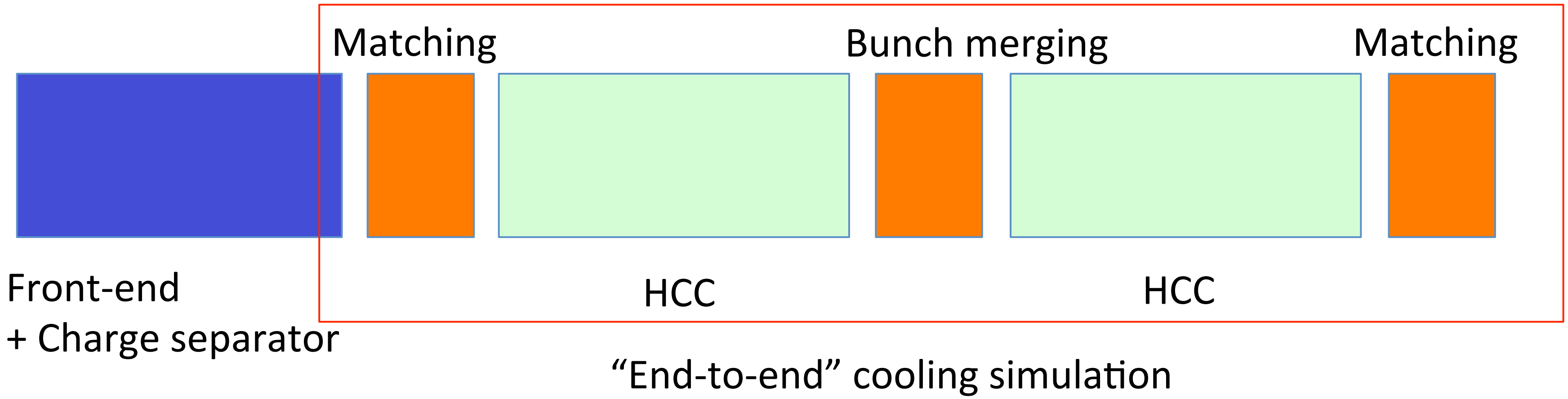
Proposed baseline 6D cooling section



- Need to demonstrate "end-to-end" cooling simulation to evaluate cooling performance
- This is NOT the final design
  - Select "primary" and "alternative" channels

Goal of the workshop

- Make a list of criteria for baseline selection
  - Find “strong points” and “challenges” in HCC
  - Distribute challenge issues in the group
- Organize group
- Schedule

Our “Strong points”

- HCC theory is very accurate
  - Estimate cooling performance from a lattice
  - Guide for optimization
    - Improved matching at RF frequency transition
    - Designed bunch merging by using features of helical magnet
- High Pressurized Hydrogen gas filled RF cavity
  - Feasible for a muon cooling channel
  - Gas-plasma dynamics is a key to have better cooling performance, i.e. a lower emittance than possible in a vacuum channel
- Developed a helical solenoid magnet technology
  - NbTi, YBCO
  - Consider BiSCCO in future

What is present “challenges”?

- Moving conceptual design to engineering design
  - How to incorporate an RF system into an HCC magnet?
    - A practical HCC design for $\lambda \geq 0.5$ m looks available
    - Find coil geometry, current (margin), and tolerance particularly for a final cooling section ($\lambda < 0.5$ m)
    - Find RF geometry, power, operating temperature (room vs. LN2 temp), thermal isolation, and tolerance
    - Additional space (> 15 %) for maintenance, plumbing, instrumentation, infrastructure
- Challenge of extrapolating to final system
  - What happens in the channel with a muon collider beam?
    - Beam loading, Plasma loading, Plasma interacting with beam
    - But, gas plasma could have a positive effect

Additional challenges

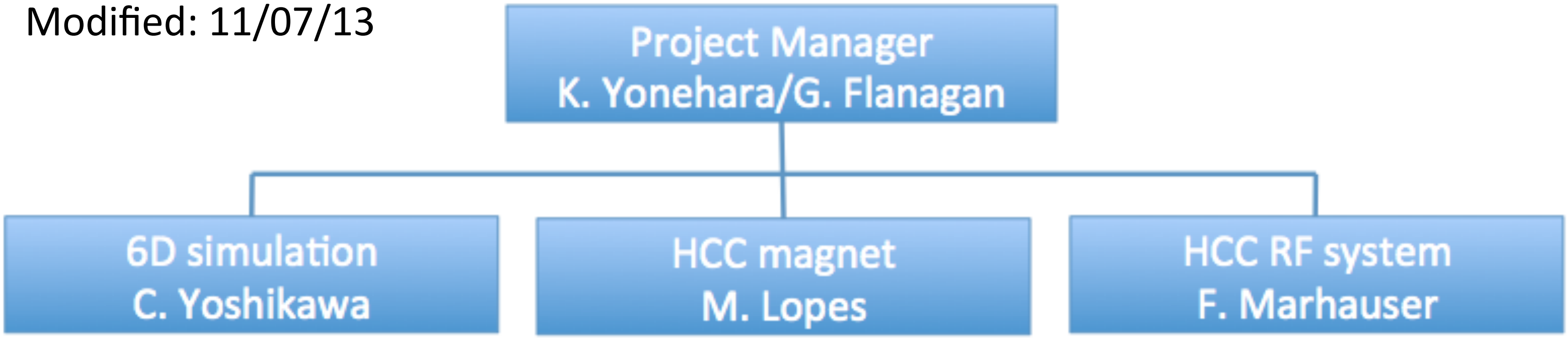
- Matching
  - How to match a front-end beam into an HCC?
- Safety aspect
  - What is a safety requirement for usage of pressurized hydrogen?
- Beam instrumentation
  - How to measure muon beam profile?
- Cryo-cooler for RF system?
  - Room temp. vs. LN2 temp.

Charge for baseline selection

- Accomplish end-to-end cooling simulation
  - Phase space matching from a charge separator to a helical channel
  - Verify HCC theory
    - Compare emittance evolution and transmission efficiency in analytical/practical EM fields
    - Test field tolerance
    - Provide lattice parameters
  - Bunch merging
- Design HCC magnet
  - Nb3Sn vs HTS for $\lambda < 0.5$ m
- Design HCC RF system
  - Investigate gas-plasma dynamics
  - Design RF for $\lambda < 0.5$ m

Organization chart

Original: 9/14/13
Modified: 11/07/13



6D simulation

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C. Ankenbrandt
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HCC magnet

G. Flanagan
J. Tompkins
S. Kahn

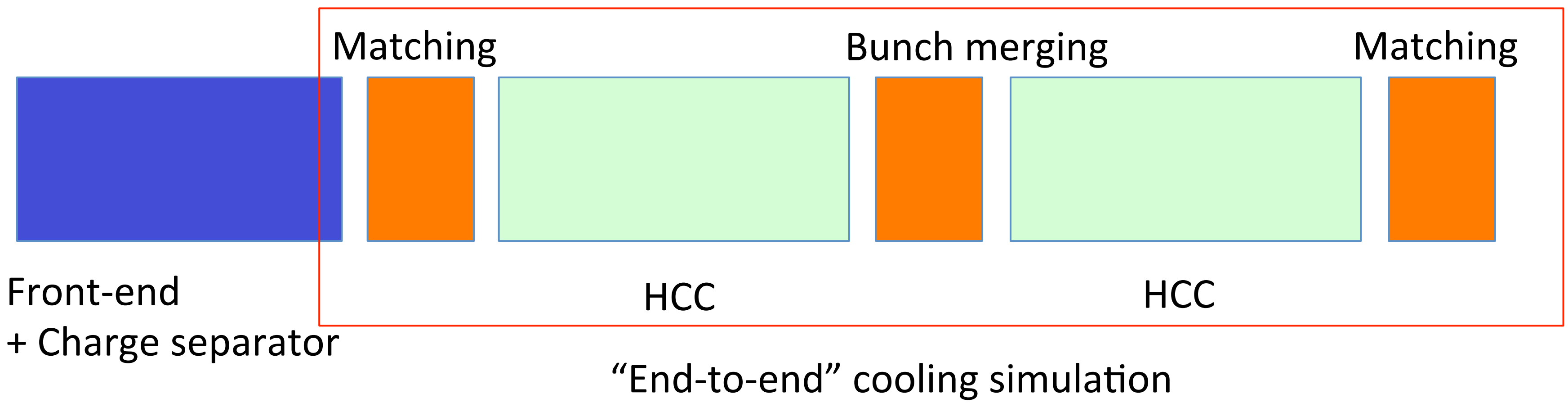
HCC RF system

A. Tollestrup
M. Chung
B. Freemire
K. Yoneahra
R. Samulyak

Additional criteria for baseline selection

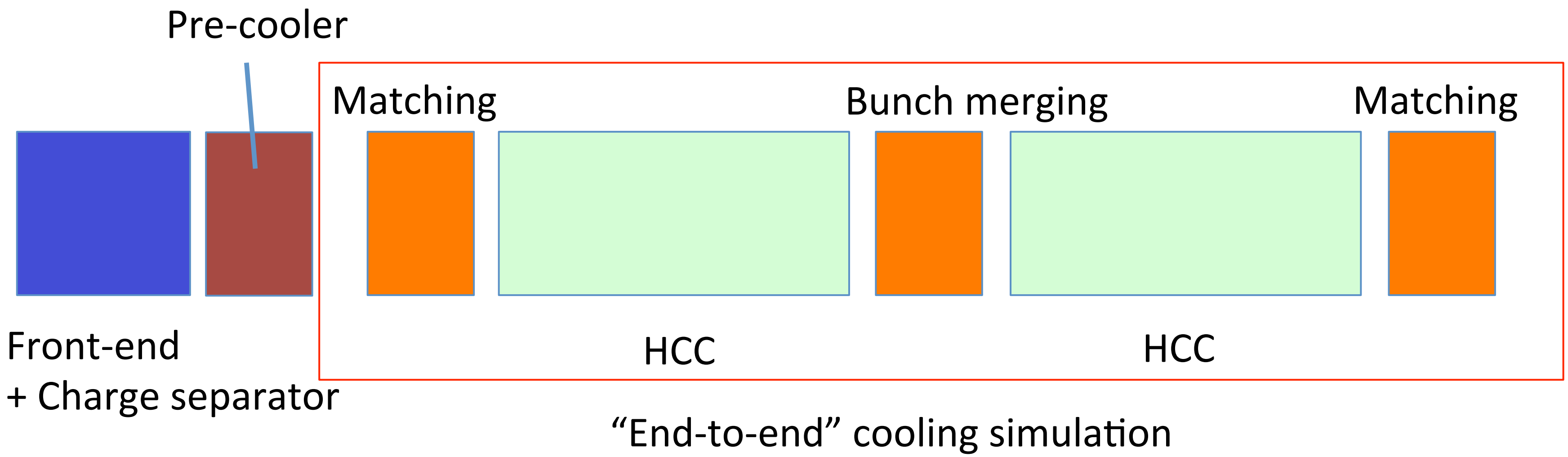
- RF must work in a multi-Tesla field
- RF must accept a muon collider beam
- What is the limit of cooling?
  - Space charge?
  - Beam loading?
  - Magnetic field?
  - RF gradient?
  - Non-linear dynamics?
  - Acceleration?

Consider possible extension



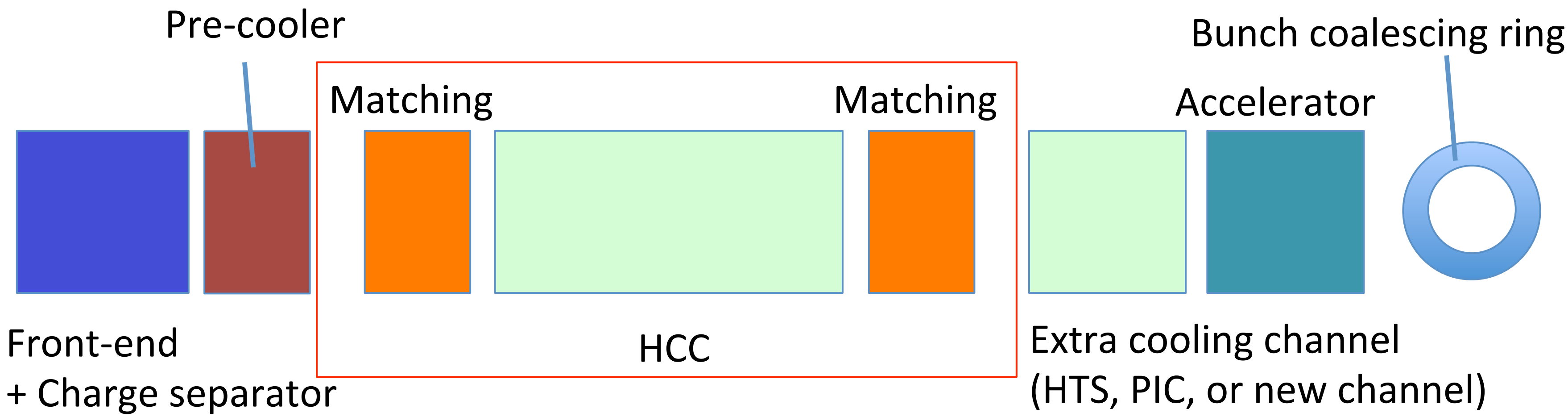
- This is NOT the final design
- In fact, the present front-end is not ideal for both a vacuum and a HPRF base cooling channel

Improve MC complex I: Front-end



- Optimize front-end channel
  - Use a snake FOFO or COBRA as a precooler in front of the charge separator

Improve MC complex II: Bunch merging



- Do we need a bunch merging here?
  - Can we merge a bunched beam at high energy?
  - Need to consider space charge effect in an extra cooling channel
    - Gas-plasma may be able to neutralize beam charge
  - Need to design a bunch coalescing ring